

WHAT IS CLAIMED IS:

1        1.        An ink jet recording apparatus, comprising:  
2                at least one main tank, which stores ink therein; and  
3                a plurality of subtanks, communicated with each main tank, each  
4        subtank storing ink supplied from the main tank, and being communicated with  
5        at least one recording head.

1        2.        The ink jet recording apparatus as set forth in claim 1, wherein a  
2        plurality of main tanks are provided.

1        3.        The ink jet recording apparatus as set forth in claim 1, wherein the  
2        subtanks are arranged in a vertical direction.

1        4.        The ink jet recording apparatus as set forth in claim 1, wherein each  
2        subtank is airtightly formed by a material having flexibility so that a volume of  
3        the subtank is variable.

1        5.        The ink jet recording apparatus as set forth in claim 1, further  
2        comprising:

3                a first ink amount detector, which detects an ink amount stored in  
4        each subtank; and

5                a first supply amount controller, which controls a supply amount of ink  
6        flowing into each subtank, based on the detection of the first ink amount  
7        detector.

6. The ink jet recording apparatus as set forth in claim 5, wherein the first supply amount controller is provided as a first valve member.

7. The ink jet recording apparatus as set forth in claim 6, wherein:  
the first valve member is opened when the first ink amount detector detects an ink low state in which the ink amount stored in the subtank is a first predetermined level or less; and

the first valve member is closed when the first ink amount detector detects an ink full state in which the ink amount stored in the subtank is a second predetermined level or more.

8. The ink jet recording apparatus as set forth in claim 1, wherein the subtank is communicated with a plurality of recording heads.

9. The ink jet recording apparatus as set forth in claim 1, wherein the main tank and the sub tanks are arranged so as to provide a head difference therebetween, to supply ink from the main tank to the sub tanks.

10. The ink jet recording apparatus as set forth in claim 1, wherein the main tank is compressed to supply ink to the sub tanks.

11. The ink jet recording apparatus as set forth in claim 10, wherein the main tank is compressed by a pump member.

1 12. The ink jet recording apparatus as set forth in claim 11, wherein the  
2 pump member is connected to the main tank via an air releaser which opens  
3 the main tank to atmosphere.

1 13. The ink jet recording apparatus as set forth in claim 6, further  
2 comprising a second supply amount controller, which controls a supply amount  
3 of ink flowing out of the main tank.

1 14. The ink jet recording apparatus as set forth in claim 13, wherein the  
2 second supply amount controller is provided as a second valve member.

1 15. The ink jet recording apparatus as set forth in claim 14, wherein the  
2 second valve member is first opened while the main tank is compressed, and  
3 then the first valve member is opened to supply ink to the subtank.

1 16. The ink jet recording apparatus as set forth in claim 14, wherein the  
2 first valve member is first closed and the compressing of the main tank is  
3 canceled when the subtank is replenished, and the second valve member is  
4 then closed.

1 17. The ink jet recording apparatus as set forth in claim 4, wherein each  
2 subtank contains a plate member which prevents inner surfaces of the subtank  
3 from being adhered with each other.

1 18. The ink jet recording apparatus as set forth in claim 17, wherein  
2 grooves are formed on surfaces of the plate member.

1 19. An ink jet recording apparatus, comprising:  
2 at least one main tank, which stores ink therein;  
3 a plurality of recording sections, communicated with each main tank,  
4 each recording section including a subtank which stores ink supplied from the  
5 main tank, and at least one recording head communicated with the subtank;  
6 and  
7 a system controller, which controls the main tank and the recording  
8 sections such that a recording section in which a time period required for  
9 supplying ink from the main tank to the subtank is shorter is controlled with a  
10 higher priority.

1 20. The ink jet recording apparatus as set forth in claim 19, wherein a  
2 recording section in which a path length connecting the main tank and the  
3 subtank is shorter is controlled with a higher priority.

1 21. The ink jet recording apparatus as set forth in claim 19, wherein each  
2 subtank is airtightly formed by a material having flexibility so that a volume of  
3 the subtank is variable.

1 22. The ink jet recording apparatus as set forth in claim 19, further  
2 comprising:  
3 a first ink amount detector, which detects an ink amount stored in

4 each subtank; and  
5 a first supply amount controller, which controls a supply amount of ink  
6 flowing into each subtank, based on the detection of the first ink amount  
7 detector.

1 23. The ink jet recording apparatus as set forth in claim 22, wherein the  
2 first supply amount controller is provided as a first valve member.

1 24. The ink jet recording apparatus as set forth in claim 23, wherein:  
2 the first valve member is opened when the first ink amount detector  
3 detects an ink low state in which the ink amount stored in the subtank is a first  
4 predetermined level or less; and

5 the first valve member is closed when the first ink amount detector  
6 detects an ink full state in which the ink amount stored in the subtank is a  
7 second predetermined level or more.

1 25. The ink jet recording apparatus as set forth in claim 19, wherein the  
2 main tank and the subtanks are arranged so as to provide a head difference  
3 therebetween, to supply ink from the main tank to the subtanks.

1 26. The ink jet recording apparatus as set forth in claim 19, wherein the  
2 main tank is compressed to supply ink to the subtanks.

1 27. The ink jet recording apparatus as set forth in claim 26, wherein the  
2 main tank is compressed by a pump member.

1 28. The ink jet recording apparatus as set forth in claim 27, wherein the  
2 pump member is connected to the main tank via an air releaser which opens  
3 the main tank to atmosphere.

1 29. The ink jet recording apparatus as set forth in claim 23, further  
2 comprising a second supply amount controller, which controls a supply amount  
3 of ink flowing out of the main tank.

1 30. The ink jet recording apparatus as set forth in claim 29, wherein the  
2 second supply amount controller is provided as a second valve member.

1 31. The ink jet recording apparatus as set forth in claim 30, wherein the  
2 second valve member is first opened while the main tank is compressed, and  
3 the first valve member is then opened to supply ink to the subtank.

1 32. The ink jet recording apparatus as set forth in claim 30, wherein the  
2 first valve member is first closed and the compressing of the main tank is  
3 canceled when the subtank is replenished, and the second valve member is  
4 then closed.

1 33. The ink jet recording apparatus as set forth in claim 21, wherein each  
2 subtank contains a plate member which prevents inner surfaces of the subtank  
3 from being adhered with each other.

1 34. The ink jet recording apparatus as set forth in claim 33, wherein  
2 grooves are formed on surfaces of the plate member.

1 35. A method of controlling the ink jet recording apparatus as set forth in  
2 any one of claims 19 to 34 to record information on a recording medium with  
3 ink.

1 36. A method of initially filling a subtank with ink stored in a main tank  
2 which is communicated with the subtank, comprising the steps of:

3 a) applying negative pressure to a recording head communicated  
4 with the subtank, to discharge air in the subtank while compressing the  
5 subtank;

6 b) opening a valve member provided between the main tank and the  
7 subtank, after the step a), to supply ink from the main tank to the subtank;

8 c) closing the valve member after the step b);

9 d) applying negative pressure to the recording head, after the step  
10 c), to discharge air and ink in the subtank while compressing the subtank; and

11 e) opening the valve member, after the step d), to supply ink from  
12 the main tank to the subtank.

1 37. The initial filling method as set forth in claim 36, further comprising:

2 f) closing the valve member, after the step e);

3 g) applying negative pressure to the recording head, after the step f),  
4 to partly discharge ink in the subtank; and

5 h) opening the valve member, after the step g), to supply ink from

6 the main tank to the subtank.

1 38. The initial filling method as set forth in claim 36, further comprising:

2 f) closing the valve member, after the step e); and

3 g) applying negative pressure to the recording head, after the step f),

4 to supply ink from the subtank to the recording head.

1 39. A method of initially filling a subtank with ink stored in a main tank  
2 which is communicated with the subtank, comprising the steps of:

3 a) applying negative pressure to a recording head communicated  
4 with the subtank, to discharge air in the subtank while compressing the  
5 subtank;

6 b) opening a valve member provided between the main tank and the  
7 subtank, after the step a), to supply ink from the main tank to the subtank;

8 c) closing the valve member after the step b); and

9 d) applying negative pressure to the recording head, after the step  
10 c), to supply ink from the subtank to the recording head.

1 40. The initial filling method as set forth in claim 36, wherein the steps c)  
2 to e) are repeated.

1 41. An ink jet recording apparatus in which the initial filling method as set  
2 forth in claims 36-40 are performed.



1 42. The ink jet recording apparatus as set forth in claim 41, wherein the  
2 main tank is located below the subtank while being compressed.

1 43. The ink jet recording apparatus as set forth in claim 41, wherein the  
2 main tank is located above the subtank.

1 44. The ink jet recording apparatus as set forth in claim 41, wherein:  
2 the subtank is airtightly formed by a material having flexibility so that a  
3 volume of the subtank is variable; and  
4 the subtank contains a plate member which prevents inner surfaces  
5 of the subtank from being adhered with each other.

1 45. An ink supply system, comprising:  
2 at least one main tank, which stores ink therein;  
3 a plurality of recording heads, communicated with each main tank  
4 while providing a head difference therebetween; and  
5 a system controller, which monitors an ink amount consumed in each  
6 recording head to manage a residual ink amount in the main tank.

1 46. An ink supply system, comprising:  
2 at least one main tank, which stores ink therein;  
3 a plurality of subtanks, communicated with each main tank, each  
4 subtank communicated with at least one recording section; and  
5 a system controller, which monitors an ink amount consumed in each  
6 subtank to manage a residual ink amount in the main tank.

1 47. The ink supply system as set forth in claim 46, wherein each subtank  
2 is airtightly formed by a material having flexibility so that a volume of the  
3 subtank is variable.

1 48. The ink supply system as set forth in claim 46, wherein the system  
2 controller starts to count the consumed ink amount of the subtank when an ink  
3 amount stored in the subtank becomes a predetermined level.

1 49. The ink supply system as set forth in claim 48, wherein the system  
2 controller regards a total ink amount consumed in all the subtanks as an ink  
3 amount consumed in the main tank.

1 50. The ink supply system as set forth in claim 46, wherein the system  
2 controller obtains the consumed ink amount of each subtank every time when  
3 the subtank is replenished with ink supplied from the main tank.

1 51. The ink supply system as set forth in claim 46, wherein the system  
2 controller selectively supplies ink to at least one subtank which requires an ink  
3 replenishment, and obtains the consumed ink amount of the at least one  
4 subtank.

1 52. The ink supply system as set forth in claim 46, wherein the system  
2 controller obtains the consumed ink amount of each subtank, and supplies ink  
3 to all the subtanks simultaneously.

53. The ink supply system as set forth in claim 46, wherein a flow rate of ink flowing into the subtank is greater than a flow rate of ink flowing out from the recording section associated with the subtank.

54. The ink supply system as set forth in claim 46, wherein the system controller starts to supply ink to the subtank when the ink amount consumed in the subtank exceeds a threshold level.

55. The ink supply system as set forth in claim 54, wherein the threshold level includes a first threshold level selected while the recording section performs recording, and a second threshold level which is smaller than the first threshold level selected while the recording is not performed.

56. The ink supply system as set forth in claim 46, wherein:  
each subtank is provided with at least one detector which detects a residual ink amount therein; and  
the system controller starts to supply ink to the subtank when the detector detects that the residual ink amount is a predetermined level or less.

57. The ink supply system as set forth in claim 56, wherein:  
a plurality of detectors are provided with each subtank; and  
the system controller starts to supply ink to the subtank when the detection of one detector is effected, and stops the ink supply when the detection of another detector is effected.

1 58. The ink supply system as set forth in claim 56, wherein the detector is  
2 solely provided.

1 59. The ink supply system as set forth in claim 58, wherein the system  
2 controller supplies ink to the subtank during the detection of the detector is  
3 effected.

1 60. The ink supply system as set forth in claim 58, wherein the system  
2 controller supplies ink to the subtank for a predetermined time period when the  
3 detection of the detector is effected.

1 61. The ink supply system as set forth in claim 54, wherein:  
2 each subtank is provided with at least one detector which detects a  
3 residual ink amount therein; and  
4 the system controller stops the ink supply when the detection of the  
5 detector is effected.

1 62. The ink supply system as set forth in claim 46, wherein the system  
2 controller supplies ink from the main tank to each subtank every time when the  
3 system is activated.

1 63. The ink supply system as set forth in claim 46, wherein the system  
2 controller supplies ink from the main tank to each subtank every time when a  
3 predetermined time period elapses.

64. The ink supply system as set forth in claim 46, wherein the system controller supplies ink from the main tank to the subtank after obtaining the consumed ink amount of each subtank to calculate a residual ink amount in the main tank, every time when the recording section performs recording.

65. The ink supply system as set forth in claim 46, wherein:  
the system controller obtains the consumed ink amount of each subtank every time when the recording section performs recording to calculate a residual ink amount in the main tank; and  
an ink end state is effected in all the recording section when the residual ink amount in the main tank is a predetermined level or less.

66. The ink supply system as set forth in claim 65, wherein the recording section continues the recording until a predetermined amount of ink in the subtank is consumed after the ink end state is effected.

67. The ink supply system as set forth in claim 46, wherein:  
the system controller sequentially compares the ink amount consumed in each subtank and a residual ink amount in the main tank;  
the system controller supplies ink to the compared subtank when the consumed ink amount of the compared subtank is less than the residual ink amount; and  
an ink end state is effected when the consumed ink amount of the compared subtank is greater than the residual ink amount.

68. The ink supply system as set forth in claim 46, wherein:

the system controller sequentially compares the ink amount consumed in each subtank and a residual ink amount in the main tank;

the system controller supplies ink to the compared subtank when the consumed ink amount of the compared subtank is less than the residual ink amount;

the system controller does not supply ink to the compared subtank when the consumed ink amount of the compared subtank is greater than the residual ink amount; and

an ink end state is effected when there is at least one subtank to which ink is not supplied.

69. The ink supply system as set forth in claim 67, wherein the ink supply is once performed even when the ink end state is effected.

70. The ink supply system as set forth in claim 67, wherein the ink supply is performed until any change is not occurred in the detector, even when the ink end state is effected.

71. The ink supply system as set forth in claim 56, wherein:

a valve member is provided between the main tank and each subtank; and

the valve member is closed when the detector detects that the residual ink amount is a predetermined level or more.

1 72. The ink supply system as set forth in claim 71, wherein each valve  
2 member is closed independently from another valve members.

1 73. The ink supply system as set forth in claim 71, wherein each valve  
2 member is closed selectively.

1 74. The ink supply system as set forth in claim 71, wherein all the valve  
2 members are closed simultaneously.

1 75. The ink supply system as set forth in claim 74, wherein all the valve  
2 members are closed when at least one detector among the detectors of the  
3 subtanks detects that one subtank is almost empty.

1 76. The ink supply system as set forth in claim 46, wherein:  
2 the main tank is provided with a first detector which detects a residual  
3 ink amount in the main tank; and  
4 an ink end state is effected when the first detector detects that the  
5 residual ink amount is a predetermined amount or less.

1 77. The ink supply system as set forth in claim 76, wherein:  
2 each subtank is provided with a second detector which detects a  
3 residual ink amount therein; and  
4 the system controller stops the ink supply when the second detector  
5 detects that the subtank is almost full when the ink end state is effected.

1 78. The ink supply system as set forth in claim 46, further comprising a  
2 memory for storing a residual ink amount in the main tank.

1 79. The ink supply system as set forth in claim 47, wherein each subtank  
2 contains a plate member which prevents inner surfaces of the subtank from  
3 being adhered with each other.

1 80. The ink jet recording apparatus as set forth in claim 79, wherein  
2 grooves are formed on surfaces of the plate member.

1 81. A method of managing an ink amount supplied from main tank to the  
2 subtanks which are provided in the ink system as set forth in any one of claims  
3 46 to 80.

1 82. The ink supply system as set forth in claim 45, further comprising a  
2 memory for storing a residual ink amount in the main tank.

1 83. A method of managing an ink amount supplied from main tank to the  
2 subtanks which are provided in the ink system as set forth in claim 45 or 82.